COMPUTER USE IN CITY TREE INVENTORIES

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Abstract

Computerized city tree inventory systems can be a valuable tool in program planning and management. We developed and tested a system for the community of Waterville, Kansas. We think the system can have widespread application.

Progressive leaders in all fields have welcomed developments that facilitate decision making and afford accuracy in projecting programs. Computer systems as a management tool are gaining widespread acceptance with facilities now readily available at relatively low cost. A computer inventory system lends itself well to city tree management by providing helpful data in developing planting plans, planning for dead-tree removal, implementing systematic maintenance scheduled, and controlling insect and disease situations.

This concept is not new as computerized tree inventory systems have been used in several large cities for several years (D'Ambrosio, 1974; Johanssen, 1975). However, few smaller towns have developed programs, and none to the authors' knowledge, in villages of fewer than 5000 population.

To test the practicality of a computerized inventory in a small town, a program was developed for Waterville, Kansas (population 761). The inventory was developed and conducted by foresters from the departments of State and Extension Forestry, Horticulture and Forestry, a statistician, and students enrolled in the course "Municipal Forestry" at Kansas State University. Waterville was chosen because it had (1) an active City Tree Board, (2) a comprehensive city tree ordinance, (3) a modest city tree budget, (4) a need for data to improve management decisions, and (5) proximity to Kansas State University.

Waterville's present city tree program was developed as part of the Kansas Community Forestry Program, administered by the Department of State and Extension Forestry at Kansas State University.

In a city tree inventory, it is desirable to obtain the following information: 1) total number of trees, 2) tree location, 3) species composition, 4) size, 5) condition, 6) management needs, and 7) planting needs. A system for collecting such data was developed for Waterville. Sample inventory forms and coding instructions are shown in Figures 1 and 2.

TREE INVENTORY

City ________ Date ________

Street ________ Block ________ Side ________

Tree #	Species	DBH	Cond.	Mgt. Need	Removal Diff.	Planting Need

Figure 1. Census form

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CITY TREE INVENTORY INSTRUCTIONS

CITY AND DATE: Fill in on first tally sheet of the day.

STREET: Use street name.

BLOCK: Use map code. Blocks are always numbered from south to north and west to east.

SIDE: Street side--east or west, north or south.

SPECIES: Use species codes on card.

DIAMETER: DBH--To nearest even numbered inch.

CONDITION: Use codes 1 through 4.

Code	
1 (good)	Really vigorous tree. No apparent signs of insect, disease, or mechanical injury. Little or no corrective work required. Form representative of species.
2 (fair)	Average condition and vigor for area. May need corrective pruning or repair. May lack desirable form characteristic of species. May show minor insect injury, disease, or physiological problem.
3 (poor)	General state of decline. May show severe mechanical, insect, or disease damage, but death not imminent. May require major repair or renovation.
4 (dead or dying)	Dead or death imminent from Dutch elm disease or other causes.

MANAGEMENT NEEDS: Use codes 1 through 8.

Code	
1	Minor pruning
2	Major pruning
3	Wound repair
4	Feeding (fertilizer or iron)
5	Insect control
6	Disease control
7	Removal
8	None

REMOVAL DIFFICULTY:

Code	
1	Easy
2	Medium
3	Difficult

PLANTING NEEDS: Base on vacant spots, and use 30'-50' spacing. Consider all restricting factors.

Code	
1	Small (mature height, 25 ft.)
2	Medium (mature height, 60 ft.)
3	Large (mature height, 90 ft.)

Figure 2. Inventory instructions for Waterville survey.

Data were analyzed using a computer program structured for social sciences (SP SSH-version 5.01) (Nie, et al., 1970). The program uses cross-tabulation of variables, which can be requested in any sequence or combination. The combination of variables is limited only by data input and user ingenuity. In the Waterville case, the Tree Board requested this information:

1. Condition class by species.
2. Management needs by species and location.
3. Planting needs by size and location.
4. Removal needs by location and difficulty class.
5. Species percentages of total tree population.

Based on this information, members of the Tree Board will revise and update their street tree management program. For example, planting requirements must be evaluated in regard to location or concentration, species selection, and number of trees to be planted. The inventory revealed that 411 new trees were needed to achieve full stocking (Table 1). As shown in Table 2, the computer output can provide that information citywide, on a given street, and on any given block by tree size category. From that information, proper selection of compatible species can be made, purchase requirements determined, and planting schedules formulated.

Street	Tree Size: Small	Medium	Large	Row Total # %
Walnut	1	0	0	1 0.2
Wyoming	6	1	3	10 2.4
Winkler	0	2	11	13 3.2
Walnut	27	14	5	46 11.2
Railroad	0	20	3	23 5.6
Nebraska	20	4	7	31 7.5
McNulty	0	0	3	3 0.7
Minnesota	9	9	7	25 6.1
Main	3	5	26	34 8.3
Lincoln	4	13	10	27 6.6
Kansas	3	1	3	7 1.7
Column Total	186 45.3%	105 25.5%	120 29.2%	411 100.0%

Table 1. Planting needs by street.

Street	Block 1.	2.	3.	4.	5.	6.	7.	8.	9.	Row Total # %
Wyoming	2	4	0	0	0	0	0	0	0	6 3.2
Walnut	2	7	4	0	2	2	10	0	0	27 14.6
Nebraska	2	4	2	2	9	0	1	0	0	20 10.8
Minnesota	0	0	1	0	5	1	2	0	0	9 4.9
Main	3	0	0	0	0	0	0	0	0	3 1.6
Lincoln	0	0	0	4	0	0	0	0	0	4 2.2
Kansas	0	1	1	0	0	0	1	0	0	3 1.6
Front	0	0	1	2	0	0	0	0	0	3 1.6
East	2	2	0	0	0	0	0	0	0	4 2.2
Division	3	4	12	12	8	0	0	0	0	39 21.1
Commercial	1	3	0	3	0	1	3	0	0	11 5.9
Column Total	31 16.8	39 21.1	22 11.9	23 12.4	27 14.6	5 2.7	21 11.4	12 6.5	5 2.7	185 100.0

Table 2. Planting needs by location for small trees.

Tree removals follow the same format. Location and concentrations are known as well as removal difficulty class (Table 3). Thus projections of equipment and man-hours, along with systematic schedules, can be formulated.

Street	Block 1.	2.	3.	4.	5.	6.	7.	8.	9.	Row Total # %
Wyoming	1	0	0	0	0	0	0	0	0	1 1.8
Railroad	1	0	1	0	0	0	0	0	0	2 3.5
Nebraska	0	1	0	0	0	0	0	0	0	1 1.8
Minnesota	0	2	3	0	3	1	0	2	0	11 19.3
Main	0	1	2	3	0	0	4	0	0	10 17.5
Lincoln	0	1	3	2	0	0	0	0	0	6 10.5
Kansas	0	0	0	0	3	0	0	0	0	3 5.3
Hazelwood	2	1	4	0	0	0	0	0	0	7 12.3
Front	0	0	4	0	0	0	0	0	0	4 7.0
Division	0	0	1	0	0	0	0	0	0	1 1.8
Commercial	0	0	0	0	0	1	0	0	0	1 1.8
Column Total	5 8.8	6 10.5	18 31.6	5 8.8	9 15.8	2 3.5	8 14.0	3 5.3	1 1.8	57 100.00

Table 3. Cross-tabulation of removal needs by location and difficulty class (difficulty).

Street	Block 1.	2.	3.	4.	5.	6.	7.	8.	9.	Row Total # %
Winkler	1	1	0	0	0	0	0	0	0	2 1.1
Walnut	4	4	3	3	3	1	1	0	0	19 10.2
Railroad	1	4	0	0	0	0	0	0	0	5 2.7
Nebraska	0	3	4	6	0	3	3	5	0	24 12.8
Minnesota	0	2	2	0	1	3	1	2	0	11 5.9
Main	0	3	1	4	4	3	0	0	0	15 8.0
Lincoln	5	2	1	1	0	0	0	0	0	9 4.8
Kansas	1	2	7	5	6	0	1	0	0	22 11.8
Hazelwood	6	2	1	0	0	0	0	0	0	9 4.8
	1	0	0	0	0	0	0	0	0	1 0.5
Division	1	1	3	3	0	0	0	0	0	8 4.3
Column Total	29 15.5	40 21.4	29 15.5	26 13.9	15 8.0	17 9.1	18 9.6	10 5.3	3 1.6	187 100.0

Table 4. Cross-tabulation of heavy pruning needs by location.

The area of individual tree management or maintenance can be addressed fully. From the computer output, management needs (pruning, wound repair, insect and disease control, etc.) can be determined citywide (Table 4). Systematic maintenance schedules can then be developed and priority areas designated for effectively assigning work crews and equipment.

As can be seen by our examples, location information requested was broken down by block. If desired, one can also require printout combinations for individual block sides or for individual trees.

The major cost in computerizing tree inventory data is for man-hours required to survey individual trees. Of course, that depends on the detail desired. The 100 percent field survey of Waterville was conducted by three groups of three individuals, each group surveying approximately 1500 trees. Forty-five man-hours were required to collect the data. With practice, three men using optical mark sense cards probably could accomplish the task in 5 hours (15 man-hours). The processing cost is minimal, however, it depends upon the amount of printout requested. The cost of the Waterville program from the Kansas State University Computing Center was approximately $20 for more than 200 pages of output. Modification of survey techniques may lower cost and streamline the system.

In larger cities with greater area and volume of trees, sub-sample techniques may be considered to reduce the expense. Usually, tract development areas are quite homogenous with respect to tree species. Therefore, instead of a 100 percent inventory, a 10 percent or 20 per cent subsample of the tree population might be all that is needed to provide adequate information for various projects. Although the specifics for individual trees are lost, all aspects of an overview are retained.

The computer program also could be modified to estimate shade tree values. Incorporating factors of the International Shade Tree Conference formula into the program would produce values for the total tree population and for each species or for individual trees. Such values can be used to stress the importance of a city's tree resources and to support budget requests. Investigating available computer systems will provide several possibilities for statistical analyses, model design, and concentration mapping.

Formulating an annual budget is a demanding task that requires factual information. How many trees need pruning, fertilizing, insect and disease control, or removal? What are the total planting requirements? The inventory data can answer those questions. Based on the computer output, purchases of supplies and materials can be accurately forecast, manpower requirements determined, and assessments made regarding contract and in-service work.

A computerized tree inventory system only provides data. Effective use of the data is the key to budget maximization. Savings in annual operating costs alone may offset cost of the inventory and computer time used. Those responsible for city forestry programs benefit from efficient operation; the trees benefit from proper care, and the residents have a better tree environment.

Literature Cited

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